MACHINE DESIGN

1976 ANNUAL INDEX

Volume 48 — January to December

Including 23 regular issues of MACHINE DESIGN plus five special issues—*The Materials Reference Issue, Electric Motors & Controls Reference Issue, Mechanical Drives, Bearings & Seals Reference Issue, Fluid Power Reference Issue, Fastening & Joining Reference Issue.* Only articles and editorial items one-half page or larger are indexed.

AUTHOR INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

Z

SUBJECT INDEX

Numbers preceding subject classifications refer to the MACHINE DESIGN SUBJECT CLASSIFICATION SYSTEM (page 12).

Editorial material in this SUBJECT INDEX is referenced as follows:

Columns

(1)	(2)	(3)	(4)	(5)
Better Motors With Rare-Earth Magnets	Rashidi	7/8	70	(4.0)

(1) Title.

(2) Author's last name (see AUTHOR INDEX for full name).
Departments in regular issues are denoted by the codes:
- N/T .... News/Trends
- DI .... Design International
- Scan .... Scanning the Field for Ideas

Articles in MACHINE DESIGN *Reference Issues* are identified by the entry: Chapter (*Ref. Issue* code).
Reference Issues are coded as follows:
- M .... Materials
- EM&C .... Electric Motors & Controls
- MD .... Mechanical Drives
- FP .... Fluid Power
- F&J .... Fastening & Joining

(3) Date of regular or *Reference* issue.

(4) Page number.

(5) Number of pages in article or item.

ELECTRICAL & ELECTRONIC

11. Motors

12. Power Supplies

13. Switches & Relays

14. Instruments & Controls

15, 16. Circuit Components, Connectors & Wiring

17. Miscellaneous Components

19. Systems & Assemblies

FLUID POWER

21, 22, 23. Fluids, Fluid Conditioners, Fluid Conductors

24. Linear Devices

25. Rotary Devices

26. Seals

27. Valves

MECHANICAL

28. Instruments & Controls

29. Systems & Assemblies

31. Power Sources

Nuclear Scoreboard: 60 Plants Up, 178 Coming	N/T	9/23	36	(0.5)
Biggest Rotary Developed for Industrial Use	N/T	6/24	10	(1.3)
Engineering Students 'Modernize' The Coal Industry	Aronson	7/8	18	(4.0)
Auto Fuel: 2 Parts Water, 1 Part Liquid Hydrocarbon	N/T	10/7	8	(0.7)
Electrolysis Separates Oil from Waste Water	N/T	11/11	12	(0.7)
Spiral Tubing Soaks Up Sun's Rays	Scan	1/22	36	(0.7)
Moving Focal Point Lightens Tracking System's Load	Scan	2/12	43	(0.5)
Rigid Foam Makes Low-Cost Heat Collector	Scan	4/8	36	(0.5)
Something In The Wind? ERDA Thinks So	Black	5/20	18	(7.0)
Advanced Turbine Designs Boost Wind-Power Potential	Black	6/10	26	(6.0)
Navy Builds an Energy-Test House	N/T	7/22	8	(0.8)
Largest Windmill to Produce 1.5 MW	N/T	9/9	6	(0.7)
Fixed Mirrors To Power City	N/T	10/7	6	(0.6)
Install Solar Panels On Your Roof?	N/T	10/7	6	(0.6)
Wind Energy + Water + Air = Food	N/T	11/25	4	(1.0)
Geothermal Research Encouraging	N/T	12/9	6	(0.5)
How Solar Energy Is Used	N/T	12/9	12	(0.5)
Pedal Power: Muscling In On The Energy Crisis	Black	9/23	30	(2.0)

32, 33, 34. Drives, Transmissions, Drive Components

Mechanical Drives: More From Less	Article	10/21	138	(2.0)
Chains	Chapter MD	6/3	20	(1.9)
Wind-Up Tensioner Keeps Chain Drive in the Running	Scan	7/22	46	(0.6)
Floating Shuttle Simplifies High-Speed Tape Drive	Scan	8/12	42	(0.5)
"Sensor" Gears Preserve Constant Velocity Ratio For Angled Shafts	Scan	1/8	34	(1.0)
Sizing Planetary Reduction Gears	Carter	6/10	108	(1.4)
'Focused' Piston Tunes Out Vibrator Dead Spots	Scan	8/26	42	(0.5)
Adjustable-Speed Drives	Chapter MD	6/3	8	(5.4)
Mechanical Drives: More From Less	Article	10/21	138	(2.0)
Chains	Chapter MD	6/3	20	(1.9)
Backpedaling Transmission Shifts Bicycle Gears	Scan	7/22	42	(0.7)
Variable-Speed Belt Drives	Morris	8/12	88	(5.0)
Power Flow in a Differential	Shen	4/8	77	(3.0)
Eccentric Transmission Shifts Speeds Without Gears	Scan	2/26	38	(1.0)
Mechanical Drives: More From Less	Article	10/21	138	(2.0)
Epoxy Plug Forms Tenacious Cable Terminal	Scan	9/9	56	(0.5)
Rigging Trims Wheels on All-Terrain Vehicle	Scan	11/25	42	(0.5)
Belt Drives	Chapter MD	6/3	22	(4.5)
Power Flow in a Differential	Shen	4/8	77	(3.0)
Gears and Gear Drives	Chapter MD	6/3	13	(7.0)
Thermoplastic Gears—Part 1: Material Properties	Shanley & Lamond	12/9	125	(5.0)
Drive Sprocket Molded from Super-Tough Nylon	N/T	8/26	8	(0.5)
Rigging Trims Wheels on All-Terrain Vehicle	Scan	11/25	42	(0.5)

35. Rotational Components

Taking a Close Look at Bearing Wear	Dalal	1/8	82	(4.0)
Power Screw or Ball Screw?	Lochmoeller	3/11	76	(4.0)
Predicting Bearing Temperature	Witte	5/20	110	(6.0)
Bearings	Chapter MD	6/3	150	(4.0)
Rolling-Element Bearings	Chapter MD	6/3	165	(10.8)
Premounted Bearings	Chapter MD	6/3	176	(1.7)
Easy Way To Find Bearing Curvature	Archibald	9/23	126	(1.7)
Large-Diameter Bearings	Pritts & Myers	10/21	129	(7.0)
Changes and Challenges in Bearing Design	Tallian	11/11	18	(6.0)
Hub Unit Bearings Toughen Off-Road Racer	N/T	11/25	6	(0.8)
Stadium Floats Into Position For Any Sport	N/T	1/8	10	(0.6)
Choosing a Rod End Bearing	Keller	2/26	90	(4.0)
Stabilizing Herringbone-Grooved Journal Bearings	Fleming & Hamrock	2/26	101	(2.0)
Metals for Nonlubricated Wear	Schumacher	3/11	57	(3.0)
Woven Fabric Shapes Exotic Bearings	Scan	5/20	46	(1.0)
Bearings	Chapter MD	6/3	150	(4.0)
Plain Bearings	Chapter MD	6/3	154	(6.2)
Sliding-Bearing Materials	Chapter MD	6/3	160	(5.3)
Swinging Pad Bearing Floats on Water	Scan	7/8	32	(1.0)
Friction Loss in Small Journal Bearings	Thoen	8/26	82	(4.0)
Couplings	Chapter MD	6/3	33	(3.3)
Universal Joints	Chapter MD	6/3	37	(2.3)
Auxiliary Components	Chapter MD	6/3	39	(4.3)
Clutches and Brakes	Chapter MD	6/3	27	(6.7)
Rating the Load Capacity of Involute Splines	Drago	2/12	104	(6.0)
Wrenching Systems For Easy Assembly	McCormick	7/22	95	(1.4)
Toggles Keep Tabs on Torque	Scan	11/11	44	(0.6)
Computer Replaces Camshaft in Experimental Engine	Scan	12/9	42	(1.0)
Eccentric Transmission Shifts Speeds Without Gears	Scan	2/26	38	(1.0)
Clutches and Brakes	Chapter MD	6/3	27	(6.7)
Rubber Hose Makes Simple Clutch	Scan	6/10	48	(0.5)
How To Do More With Wrapped-Spring Clutches	Lowery & Mehrbrodt	7/22	78	(6.0)
New Bus Stresses Comfort and Convenience	NT	7/8	4	(0.7)
Specialty Bearings	Chapter MD	6/3	178	(10.1)
New Materials for Flywheels	Article	9/9	140	(0.5)

36, 37. Mechanisms, Controls

Dynamic Distortion in Cam Systems	Tesar & Matthew	3/25	186	(6.0)
Cams That Cushion Cylinders	Shasha	4/22	76	(1.8)
3-D Linkages Simplify Complex Mechanisms	Rice	6/10	100	(5.0)
Four-Bars For Limited Space	Rao	6/24	110	(0.8)
Positioning Fixture Saves Setup Time	Scan	9/23	50	(0.7)
Defining 'Precision' In A Control System	Sethi	4/8	80	(5.0)
Gentle Squeeze Puts the Brakes on Speeding Parts	Scan	7/8	36	(0.6)
3-D Linkages Simplify Complex Mechanisms	Rice	6/10	100	(5.0)
Power Screw or Ball Screw?	Lochmoeller	3/11	76	(4.0)
Tradeoffs In Clutch Actuation	Beercheck	9/9	120	(6.0)
Two-Speed Control Positions Machine Tools	Scan	9/23	54	(0.7)
Frequency Control Fine Tunes Feeder Performance	Scan	7/8	38	(0.6)
Tool Shop Open to Ocean Depths	N/T	11/25	12	(0.7)
Centrifugal Force Blends No-Lump Mixtures	Scan	12/9	46	(0.6)
C-Clamp Forms Simple Pressure Transducer	Scan	9/23	49	(0.7)
Lower Cost Protection For RR Crossings	Article	10/7	30	(2.0)

39. Systems

Changes and Challenges in Bearing Design	Tallian	11/11	18	(6.0)

ASSEMBLY COMPONENTS

41, 42, 43. Fasteners, Springs & Isolation Devices, Misc.

New Coater and New Coatings Developed for Fasteners	N/T	3/11	6	(0.5)
How Special Fasteners Improve a Product	Trilling	5/6	102	(4.0)
Fasteners and Adhesives/76	Chapter FJ	11/18	2	(3.0)
Plastic Fasteners	Chapter FJ	11/18	119	(2.3)
Breakaway Insert Speeds Installation	Scan	10/7	54	(0.7)
Inserts That Stay Put	Strasser	11/11	142	(4.0)
Nuts and Inserts	Chapter FJ	11/18	13	(7.3)
Tolerant Threads Mate With Standard Fasteners	Scan	12/9	44	(0.5)
Non-Threaded Fasteners	Chapter FJ	11/18	80	(1.6)
Latch and Trip Mechanisms	Ram	2/26	99	(2.0)
Quick-Operating Fasteners	Chapter FJ	11/18	126	(2.6)
Which Standards for Metric Retaining Rings?	Millheiser	2/26	86	(4.0)
Retaining Rings	Chapter FJ	11/18	81	(3.4)
Non-Threaded Fasteners	Chapter FJ	11/18	76	(4.0)
Optimum Bolt Head Design	Article	6/10	109	(0.6)
Safer Tightening For Bolted Joints	Rice	6/24	100	(5.0)
Wrenching Systems For Easy Assembly	McCormick	7/22	95	(1.4)
Repositioned Threads Give Fastener Wide Tolerance Range	Scan	10/7	52	(0.5)
Bolts, Screws, and Studs	Chapter	11/18	5	(7.7)
Washers	Chapter FJ	11/18	90	(1.0)
Gage Ring Indicates Fastener Tension At a Touch	Scan	1/22	40	(0.5)
Clamping Fixture Squares Wood Frames	Scan	4/22	34	(0.7)
Tapered Tapes Make Tough Joints	Scan	5/6	40	(0.7)
Pipe Clamp Plugs Leaky Joints Without Shutdown	Scan	9/9	58	(0.5)
Formed Metal Fasteners	Chapter FJ	11/18	118	(1.7)
Fatigue Failure In Springs	Kurasz	5/6	106	(5.0)
Stamped Spring Steel Fasteners	Chapter FJ	11/18	122	(2.5)
"Springs" That Don't Fatigue	Zahid	2/12	110	(3.0)
Infinite Life Torsion Springs	Kock	2/12	119	(1.5)
Minimum Length Springs	Agrawal	5/20	128	(1.0)

44. Mechanical Measurement Equipment

MATERIALS

51, 52. Ferrous, Nonferrous Metals

53, 54. Plastics, Rubber & Elastomer

55, 56. Joining Materials, Other Nonmetals

57. Finishes, Coatings, Lubricants

Low-Friction Coating Proves Its Worth in Truck Engine	N/T	2/12	12	(0.7)
Coatings That Cut Friction	Seitzinger	10/21	114	(6.0)
Chrome Deeply Diffused into Mild Steel	N/T	11/11	6	(0.6)
Waging War on Rust: Part 2—Resisting Rust	Bittence	11/11	146	(7.0)

58. Prefabricated Forms

The Latest in Structural Plastic Panels	Dreger	6/10	105	(3.0)
Plastic Converts Van into Armored Truck	N/T	6/24	6	(0.8)
Material Assembled Atomic Layer by Atomic Layer	N/T	10/21	8	(0.7)
Composite Wing Scheduled for Testing On Twelve Aircraft	N/T	3/11	6	(0.5)
Reinforced Plastic Parts from Low-Pressure Molds	Dreger	1/8	75	(3.0)
Structural Foam	Chapter M	3/4	164	(0.8)
Smooth Finish Molded Into Structural Foam Parts	N/T	3/25	8	(0.7)
Urethane Foam from a Pressurized Can	N/T	10/21	28	(0.8)

MANUFACTURING PROCESSES

61, 62, 63. Metals Casting, Shaping, Forming

Coming: 21 Casting Sealing Centers	N/T	3/25	10	(0.7)
Vacuum Lowers Cost of Investment Castings	Dreger	4/22	62	(4.0)
The Promise of Quick-Quench Materials	Aronson	12/9	20	(4.0)
Hot Isostatic Pressing To Save Air Force Dollars	N/T	5/6	10	(0.8)
Forgings By The Thousands	Dreger	7/8	57	(3.0)
Strong, Low-Cost Forgings From Sprayed-Metal Preforms	Dreger	8/12	86	(2.0)
Hot Isostatic Pressing	Aronson	9/23	118	(5.0)
Extruded Ribs Form Warp-Free Aluminum Panels	Scan	4/8	39	(0.7)
Recipe For Well-Done Staking	Strasser	12/9	154	(2.0)
Pore Profiles Leading to Improved Materials	N/T	2/26	10	(0.7)
7 x Boost in Wear Resistance for Aluminum P/M Parts	N/T	8/12	8	(0.8)
The Promise of Quick-Quench Materials	Aronson	12/9	20	(4.0)
Sheet-Metal Seams	Strasser	9/9	137	(2.0)
Photoelastic Method Evaluates Metal Stampings	N/T	4/8	8	(0.8)
Resonance Reveals Drawability Data	Scan	6/24	48	(1.0)
Formability of Steel Sheets Improved by Temperature Control	N/T	11/11	32	(0.5)
Stampable Plastics Challenge Sheet Steel	Dreger	12/9	134	(6.0)

64, 65. Metal Joining, Removal

Plastic Joining	Chapter FJ	11/18	163	(3.0)
Electromagnet Puts Welding Arc in Its Place	Scan	9/9	54	(1.0)
Welding Processes	Chapter FJ	11/18	146	(3.4)
Anaerobic Solves Weld-Porosity Problem	N/T	4/22	6	(0.8)
Ten Tips For Better Weldments	Strasser	4/22	72	(4.0)
HSLA I-Beams Welded Together	N/T	7/22	12	(0.8)
Welded Fasteners	Chapter FM	11/18	24	(3.0)
Electron Beams Tackle Tough Machining Jobs	Drew	2/26	94	(5.0)
Ultrasonic Joining Wins New Jobs	N/T	3/25	34	(0.8)
Brazing Processes	Chapter FJ	11/18	149	(3.1)
Saturated Vapor Solders Complex Parts	Scan	3/25	52	(0.6)
Hot Air Blasts Excess Solder From PC Boards	Scan	5/6	45	(0.5)
Moving Probe Pinpoints Plated Through Hole Quality	Scan	6/24	46	(0.6)
Groovy Iron Aids IC Extraction	Scan	10/21	42	(0.5)
Soldering Processes	Chapter FJ	11/18	152	(2.5)
New Metalworking Processes Tried on Jet-Engine Fairing	N/T	10/7	18	(0.5)
Structural Adhesive Bonding	Graham	10/7	118	(6.0)
Crawler Drill Takes to the Sea	N/T	2/12	10	(1.3)
Machine Tool Checks Up on Itself	Scan	4/22	33	(1.0)
A 'Jigsaw' for Hardened Alloys	Scan	10/21	43	(0.5)
Electron Beams Tackle Tough Machining Jobs	Drew	2/26	94	(5.0)
Machining By Wire	Dreger	9/9	126	(3.0)

67, 68. Finishing, Plastics & Rubber Processes

Coming Soon: Low-Cost Product Aluminum Plating	Dreger	3/11	81	(1.1)
Electroplating With a Pen	Scan	8/26	42	(0.5)
Electron Beams Tackle Tough Machining Jobs	Drew	2/26	94	(5.0)
Strong, Low-Cost Forgings From Sprayed-Metal Preforms	Dreger	8/12	86	(2.0)
Flame Spraying To Solve Metal Wear	N/T	12/9	8	(0.5)
Resin Injection Molding	Dreger	5/20	103	(3.0)
Pinpoint Control Refines Rotary Blow Molding	Scan	11/25	44	(1.0)
Twin Screws Speed Up Plastic Extrusion Process	Scan	2/12	44	(0.6)
New Metalworking Processes Tried on Jet-Engine Fairing	N/T	10/7	18	(0.5)
Reinforced Plastic Parts from Low-Pressure Molds	Dreger	1/8	75	(3.0)
Laminated Plastics	Chapter M	3/4	164	(1.9)
Plastic Parts Produced by Spin-Casting	N/T	9/9	10	(0.6)
Woven Fabric Shapes Exotic Bearings	Scan	5/20	46	(1.0)

69. General

GMC's General: First 'Finite-Element' Truck	N/T	7/22	4	(1.7)
Automatic Assembly	Chapter FJ	11/18	28	(2.5)

DESIGN THEORY & TECHNIQUES

71, 72, 73. Mechanics, Strength of Materials and Parts

Properties of Plane Cross Sections	Wojciechowski	1/22	105	(1.6)
Calc Program Finds Moments of Inertia	Genneken	10/7	138	(1.0)
Dynamic Distortion in Cam Systems	Tesar & Matthew	3/25	186	(6.0)
Avoiding Vibration In Odd-Shaped Printed-Circuit Boards	Steinberg	5/20	116	(4.0)
The 'Hidden Message' In Mechanical Vibration	Lang	6/10	86	(6.0)
Preventing Vibration Damage in Electronic Assemblies	Steinberg	7/8	74	(4.0)
A Quick, Graphical Way to Analyze Rotor Whirl	Nelson & Glasgow	10/7	124	(7.0)
Listening For The Sounds of Bearing Trouble	Beercheck	11/25	82	(5.0)
Dynamic Distortion in Cam Systems	Tesar & Matthew	3/25	186	(6.0)
Noise Standards Set for Locomotives, Portable Air Compressors	N/T	3/11	8	(0.5)
Taking Accurate Noise-Level Readings	Bentley	6/10	110	(1.0)
Holey Plate Squelches Noisy Pumps	Scan	6/24	44	(0.5)
Coming: Quieter Pumps	Robbins & Logan	9/9	116	(4.0)
Muffling Hydraulic Systems	Skaistis & Becker	10/21	124	(5.0)
Listening For The Sounds of Bearing Trouble	Beercheck	11/25	82	(5.0)
Thick-Wall Cylinders Under External Pressure	Zanker	3/11	80	(1.0)
Why Glass Parts Fail	Matheson	1/22	79	(5.0)
Rating the Load Capacity of Involute Splines	Drago	2/12	104	(6.0)
When ICs Go Bad	Dicken	2/26	78	(4.0)
A New Look at Burst Pressure	Blake	8/22	97	(1.4)
Microcapsules Give Early Warning of Fatigue Cracks	Scan	1/8	36	(0.5)
A Fresh Look At Fatigue	Wirsching & Kempert	5/20	120	(4.0)
Models That Predict Fatigue Failure	Wirsching & Kempert	7/8	65	(5.0)
Fatigue Failure in the Real World	Wirsching & Kempert	8/26	86	(5.0)
Design Codes That Fight Fatigue	Wirsching & Kempert	9/23	108	(6.0)
Designing the Leakproof Gasket	Swick	1/22	100	(4.0)
You *Can* Predict Creep in Plastic Parts	Rondeau	3/11	67	(5.0)
Thermal Stresses in Cylinders	Ganapathy	1/8	91	(1.3)
Taking a Close Look at Bearing Wear	Dalal	1/8	82	(4.0)
Spring Loading Extends Range of Friction Tester	Scan	3/11	40	(0.6)
Wear Particles Predict Machine Malfunctions	Aronson	6/24	84	(6.0)
Curing Slider Hang-Ups	Kleven	6/24	105	(5.0)

7 x Boost in Wear Resistance for Aluminum P/M Parts	N/T	8/12	8	(0.8)
Friction Loss in Small Journal Bearings	Thoen	8/26	82	(4.0)
A New Look At Burst Pressure	Blake	8/22	97	(1.4)
Simplified Hertz Stress Calculations	Modrey & Blair	12/9	152	(2.0)
Bending Stress in Curved Beams	Neugebauer	1/22	104	(1.8)
Fatigue Failure In Springs	Kurasz	5/6	106	(5.0)
Stresses In Curved Beams	Neugebauer	5/6	111	(2.0)
Beam Deflections for Complex Loads	Halasz	9/23	128	(1.3)
Infinite Life Torsion Springs	Kock	2/12	119	(1.5)
Safer Tightening For Bolted Joints	Rice	6/24	100	(5.0)
Check The Body Radius For High Stress	Article	6/24	110	(1.2)
Toggles Keep Tabs on Torque	Scan	11/11	44	(0.6)
Stresses In Circular Plates	Tabakman & Lin	7/22	84	(6.0)
Stress Analysis of Pressurized Panels	Martinelli	12/9	149	(3.0)
Thermal Stresses in Cylinders	Ganapathy	1/8	91	(1.3)
Thick-Wall Cylinders Under External Pressure	Zanker	3/11	80	(1.0)
Curing Slider Hang-Ups	Kleven	6/24	105	(5.0)
A Quick, Graphical Way to Analyze Rotor Whirl	Nelson & Glasgow	10/7	124	(7.0)
Stress Analysis of Pressurized Panels	Martinelli	12/9	149	(3.0)

74. Human-Factors Engineering

Colonizing Free Space	Comella	5/6	26	(5.0)
Human Factors—The Forgotten Element in Design	McDonald	9/9	108	(8.0)
Safety Car Built of Clay	N/T	2/26	12	(0.5)
Crushable Panels Would Save Lives	N/T	4/22	4	(0.8)
Ready-Made Space Suits and Rescue Balls	N/T	5/6	4	(0.7)
Restraint Protects the 'Codriver'	N/T	6/10	4	(0.8)
Lower Cost Protection for RR Crossings	Article	10/7	30	(2.0)
Exerciser Monitors Rider's Heart	N/T	10/21	4	(0.6)
Double Valve Combines Series & Parallel Flow	Scan	10/21	38	(1.0)
Engineering In Sports: Football Helmets	Wise	11/25	26	(3.0)
What's Behind The UL Label?	Plesser	11/25	87	(5.0)
Student Designers Specialize in Devices for the Handicapped	N/T	10/21	6	(0.5)
Newly Designed Knee Lets Many Burn Their Crutches	N/T	4/8	10	(0.7)

75. Design Analysis & Synthesis

The nth Root Revisited	Beercheck	1/8	93	(0.5)
I²L—The Coming Logic	Article	1/22	109	(0.5)
Minicalcs Find Supersonic Boundary-Layer Thickness	Logan & & Mekuria	2/12	118	(1.3)
Defining 'Precision' In A Control System	Sethi	4/8	80	(5.0)
Models That Predict Fatigue Failure	Wirsching & Kempert	7/8	65	(5.0)
Preventing Vibration Damage in Electronic Assemblies	Steinberg	7/8	74	(4.0)
Statistics From The Tail of the Curve	Wood	8/12	93	(3.0)
Calc Program Finds Moments of Inertia	Genneken	10/7	138	(1.0)
Finding the "Right" Pictorial View	Felstein	2/12	117	(1.1)
Graphic Input Terminal Uses Wireless Stylus	Scan	4/22	36	(0.7)
Calc Program Finds Moments of Inertia	Genneken	10/7	138	(1.0)
Instant Replay in the Product Development Lab	Aleks	10/21	120	(4.0)
Computer Programs For Analyzing Rotor Systems	Reiger	1/22	89	(7.0)
Shuttle Model Confirms Heating Problem	N/T	6/24	4	(0.8)
Models That Predict Fatigue Failure	Wirsching & Kempert	7/8	65	(5.0)
Computer Programs For Analyzing Rotor Systems	Rieger	1/22	89	(7.0)
Calc Programs Find Involutes	Reynolds	3/11	82	(0.8)
Strain Gages Zero-In Big Gun Quickly	Zimmerman	5/20	36	(2.0)
Hydraulic Systems With Precision Reflexes	Dransfield & Labrody	5/20	106	(4.0)
Machine Tools Embrace New Technology	Article	8/26	70	(8.0)
Renewal Theory—predicting product failure and replacement	McCall	3/25	149	(6.0)
Defining 'Precision' In A Control System	Sethi	4/8	80	(5.0)
Simple Guide to TP Dimensioning	Spotts	1/8	86	(5.0)
Simple Guide to TP Dimensioning	Spotts	1/22	84	(5.0)
No Touch Alignment System Works Without Gages	Scan	4/8	35	(1.0)
Monte Carlo Simulation for Setting Dimensional Tolerances	Corlew & Oakland	5/6	91	(5.0)

76. Basic Sciences & Fields

Evidence of New (Old) Elements Rock Physicists	N/T	7/22	22	(0.6)
Heat Pictures Tell the Inside Story	Aronson	2/12	99	(5.0)
Pipe Lines for Electricity	Article	3/25	26	(5.0)
Fireplace Damper Moved Away from the Firebox	N/T	8/26	18	(0.6)
Computing Temperature Losses	Reimann	11/11	153	(1.7)
Gamma Rays Find the Weapon	N/T	4/22	10	(1.3)
Radiation-Cured Coatings	Lindstrom, Arons & Rafferty	5/6	96	(6.0)
Newly Designed Knee Lets Many Burn Their Crutches	N/T	4/8	10	(0.7)
Colonizing Free Space	Comella	5/6	26	(5.0)
Exerciser Monitors Rider's Heart	N/T	10/21	4	(0.6)
Optical Waveguides Carry TV into Homes	N/T	9/9	10	(0.8)
Photoelectric Systems: Industry's Electronic Eyes	Filichowski	10/7	102	(6.0)
Instant Replay in the Product Development Lab	Aleks	10/21	120	(4.0)
Screen Cuts Fuel Consumption by 15%	N/T	6/10	10	(0.5)
Sailplane and Model Teamed in New Research	N/T	12/9	4	(0.7)

77. Experimental Design

Photoelastic Method Evaluates Metal Stampings	N/T	4/8	8	(0.8)
Stresses In Circular Plates	Tabakman & Lin	7/22	84	(6.0)
Fracture-Mechanics Analysis Checks Out Alaska Pipeline	N/T	12/9	10	(0.6)
Stress Analysis of Pressurized Panels	Martinelli	12/9	149	(3.0)

78. Environmental Design

Waging War on Rust: Part 1—Understanding Rust	Bittence	10/7	108	(6.0)
Waging War on Rust: Part 2—Resisting Rust	Bittence	11/11	146	(7.0)
Ready-Made Space Suits and Rescue Balls	N/T	5/6	4	(0.7)
Colonizing Free Space	Comella	5/6	26	(5.0)
Shuttle Model Confirms Heating Problem	N/T	6/24	4	(0.8)
U.S. Technology Reaches Mars	Zimmerman	6/24	18	(8.0)
NASA Recruits Space-Shuttle Astronauts	N/T	8/12	10	(0.7)
Countdown For The Orbital Express	Zimmerman	9/23	20	(6.0)
'Enterprise' Rollout	N/T	10/21	18	(1.0)
Crawler Drill Takes to the Sea	N/T	2/12	10	(1.3)
Sea-Bottom Plow Buries Transoceanic Cable	Cobb	8/12	26	(3.0)
Tool Shop Open to Ocean Depths	N/T	11/25	12	(0.7)
Huge Pressure Vessel To Test Navy's Deep-Diving Gear	N/T	12/9	6	(0.5)
EPA Wants Tougher Evaporative Standard for Autos	N/T	2/26	12	(0.5)
Metals for Nonlubricated Wear	Schumacher	3/11	57	(3.0)
Electrolysis Separates Oil from Waste Water	N/T	11/11	12	(0.7)

ENGINEERING MANAGEMENT & OPERATION

81. Engineering Department Operations

When and How to Delegate	Raudsepp	1/8	66	(4.0)
What Bugs Engineers?	Imberman	9/9	104	(4.0)
Motivation Is More Than Gimmicks	Fuller	11/11	116	(5.0)
Take the Guesswork Out of Project Time Estimates	Delembo	8/26	66	(4.0)
Technological Forecasting	Hart	2/12	90	(4.0)
Planning: The Key To Increased Engineering Productivity	Murdick & Karger	5/20	100	(3.0)
Decision Making: A Little Technique Goes A Long Way	Fuller	7/22	64	(5.0)
Take the Guesswork Out of Project Time Estimates	Delembo	8/26	66	(4.0)
NASA Recruits Space-Shuttle Astronauts	N/T	8/12	10	(0.7)
Ten Key Factors Affecting Your Job	Zimmerman	10/21	20	(6.0)
Career Stalled?	Ference, Stoner & Warren	3/25	130	(5.0)
Engineer Salaries: Where Do We Stand?	Zimmerman	2/26	18	(4.0)
More About Money	Zimmerman	5/20	31	(1.2)
EMC Gives 5th Report on Technician Salaries	Zimmerman	5/20	33	(0.8)
Inflation Out-Paces Engineers' Paychecks	Zimmerman	8/12	72	(4.0)
Personal Communications: The Space Factor	Dalton & Dalton	9/23	94	(5.0)
Purchasing: Where Does The Engineer Fit In?	Comella	12/9	120	(5.0)

82, 83. New Product Development, Drafting & Reproduction

84. Laboratory & Testing

85. Technical Information

86, 87. Patents & Patent Law, Personnel & Professional

COMPLETE MACHINES

911. Ordnance

912. Machinery

913. Electrical Machinery

914. Transportation

916. Fabricated Metal Products

917. Leisure and Hobby

CLASSIFICATION SYSTEM

The classification system provides nine major (one-digit) classifications, each of which has up to nine (two-digit) sub-classifications. These, in turn, are divided into ten (three-digit) indexing classifications.

Indexing classifications ending in 0 (General) are used to index material concerning several or all indexing classifications ending in 1 through 8. Classifications ending in 9 (Other) are used for material falling within the sub-classification but not within any of the items 1 through 8.

1—ELECTRICAL AND ELECTRONIC

11 Motors
110 General
111 Fractional (less than 1 hp)
112 Ac integral horsepower, induction
113 Dc integral horsepower
114 Universal (dc or ac)
115 Multispeed
116 Gearmotor
117 Torque
118 Definite and special purpose, pancake
119 Other: Linear, motor protectors

12 Power Supplies
120 General
121 Batteries, battery chargers, battery holders
122 Dc generators, motor-generators
123 Ac generators, motor-generators, alternators
124 Converters, inverters
125 Transformers, voltage regulators
126 Fuel cells, solar cells, photo cells
127 Thermoelectric supplies
128 Antennas
129 Other

13 Switches and Relays
130 General
131 Mechanical: Pushbutton, toggle, rotary, acceleration
132 Thermally operated: Thermostats, thermistors
133 Pressure operated
134 Limit, snap-action
135 Proximity, photoelectric, magnetic, Hall effect
136 Stepping
137 Relays, circuit breakers
138 Motor starters, motor controls, contactors, starting reactors
139 Other: Reed, mercury-wetted

14 Instruments and Controls
140 General
141 Sensing devices, transducers, thermocouples
142 Solenoids, electric actuators
143 Timers, timing motors, delays
144 Synchros
145 Instrument motors, synchronous
146 Data recorders, readouts, indicators, displays, memories
147 Meters, gages
148 Servo motors, stepping motors
149 Other: Motor silencers

15 Circuit Components
150 General
151 Resistors, varistors, rheostats, potentiometers
152 Capacitors
153 Inductors
154 Solid-state devices: Diodes, transistors, thyristors, SCR's, rectifiers, semiconductors, optical couplers, integrated circuits
155 Tubes, cathode ray tubes
156 Saturable reactors, magnetic amplifiers
157 Fuses, fuse panels, protectors
158 Lasers, masers
159 Other

16 Connectors and Wiring
160 General
161 Rings, brushes, commutators, rotors
162 Terminals, binding posts, terminal boards
163 Contacts, button
164 Plugs, receptacles, connectors, sockets
165 Wiring, cable, cord, harness, bus bars, coaxial, circuits, grounding
166 Printed circuits, stitched circuits
167 Superconductors
168
169 Other: Lenses, mirrors, reticles, reflectors, prisms, photosensors

17 Miscellaneous Components
170 General
171 Magnets, electromagnets
172 Chassis, control panels, keyboards
173 Insulation, encapsulation, shielding, jacketing, conduit
174 Cooling elements
175 Lamps, lighting elements, fiber optics, strobes
176 Heaters, heating elements, ovens
177 Electric clutches, electric brakes
178 Ignition systems
179 Other

19 Systems & Assemblies
190 General
191 Amplifiers, preamps
192 Control systems: Regulators, numerical control, digital controllers
193 Electronic computers, calculators, peripheral equipment
194 Microprocessors
195 Adjustable-speed drives
196 Servomechanisms
197
198 Packaging (electrical/electronic)
199 Other

2—FLUID POWER

21 Fluids
210 General
211 Hydraulic fluids
212 Coolants, refrigerants
213 Cleaners, solvents (see 577)
214 Lubricants (see 576)
215
216
217
218 Aerosols, pressurized liquids
219 Other

22 Fluid Conditioners
220 General
221 Fluid storage, pressure vessels, reservoirs
222 Filters, strainers, screens, baffles
223 Renovators (Note, 223 = 222 + 286 + 296)
224 Heat exchangers
225 Coolers, radiators, heat pipes
226 Heaters, burners
227 Driers, evaporators
228 Humidifiers, mixers, carburetors
229 Other

23 Fluid Conductors
230 General
231 Tubing (pressure) (see 587)
232 Hose, ducts, bellows
233 Pipe
234 Fittings
235 Joints, couplings, unions, flanges, adapters
236 Mufflers
237 Hydrofoils
238
239 Other: Applicators, dispensers, reversers

24 Linear Devices
240 General
241 Cylinders, pistons, cylinder mounts
242 Accumulators
243 Intensifiers, boosters, rams
244 Actuators, bellows, diaphragms
245 Pumps
246 Motors
247
248 Compensators
249 Other: Impellers, air guns

25 Rotary Devices
250 General
251 Pumps, rotary, centrifugal
252 Fluid motors, brakes, high-torque low-speed
253 Air motors
254 Compressors
255 Rotary actuators
256 Winches
257 Propellers (see 357)
258 Centrifuges
259 Other

2—FLUID POWER (continued)

26 Seals
260 General
261 Material seals (O-ring)
262 Mechanical seals
263 Gaskets
264 Wiper rings, piston rings
265 Packings
266 Labyrinths
267
268 Bellows, protective covers
269 Other: Diaphragms, rolling diaphragms, closures, plugs

27 Valves
270 General
271 Directional control
272 Flow control, faucets, flow dividers
273 Pressure control, relief vacuum breakers
274 Servo valves
275 Valve blocks, manifolds
276 Nozzles, venturies, orifices, poppets
277 Proportional flow or pressure
278
279 Other

28 Instruments & Controls
280 General
281 Test stands
282 Control panels
283 Meters, gages: Manometers, flow meters, rotameters, anemometers
284 Switches, liquid level
285 Transducers (to hydraulic)
286 Regulators
287 Fluid logic, fluidics, moving-part logic
288
289 Other: Floats, anchors

29 Systems & Assemblies
290 General
291 Industrial hydraulic & pneumatic systems
292 Mobile, aircraft, marine
293 Hydrodynamic drives
294 Hydrostatic drives
295 Vacuum
296 Lubrication
297 Hydraulic, pneumatic computers
298 Power units
299 Other: Servo systems

3—MECHANICAL

31 Power Sources
310 General, energy
311 Jet engines
312 Internal combustion engines
313 Turbines, turbofans, turbojets
314 Atomic, nuclear power
315 Exotic fuel engines, rockets
316 Fuels, propellants, explosives, coal, natural gas, hydrogen, fuel oil
317 Steam
318 Geothermal, wind, water, solar, tidal
319 Other

32 Constant-Speed Drives & Transmissions
320 General: Speed reducers
321 Chain
322 Belt
323 Friction: Ball, disc, wheel, cone
324 Gear
325
326
327
328
329 Other: Reversing

33 Adjustable-Speed Drives & Transmissions
330 General: Speed reducers
331 Chain
332 Belt
333 Friction: Ball, disc, wheel, cone
334 Gear
335
336
337
338
339 Other: Reversing

34 Drive Components
340 General
341 Transmission chain, cable, cable fittings, cable splices, shackles
342 Belts, belting
343 Gears, gearing, racks, pinions
344 Sprockets
345 Pulleys, sheaves, idlers, tensioners
346 Conveyor chain, conveyor belts
347 Conveyor screws, roller conveyors
348
349 Other

35 Rotational Components
350 General
351 Antifriction bearings: Ball, roller, needle, linear, thrust, pillow blocks
352 Sleeve bearings: Gas, solid-lubricant, bushings, rod ends, ball joints
353 Flexible couplings, universal joints, flexible shafts
354 Torque converters, fluid couplings
355 Shafts, axles, splines, crankshafts, spindles
356 Clutches, brakes, power absorbers, torque limiters
357 Fans, blowers, propellers (see 257)
358 Reels, winches, hoists
359 Other: Flywheels

36 Mechanisms
360 General
361 Cams, cam followers
362 Linkages, cranks
363 Intermittent-motion, periodic-motion, indexing, gyratory-motion, mechanical escapements, ratchets
364 Three-dimensional
365 Motion converters, leadscrews, jacks, actuators
366 Spring motors
367 Telescoping members, collapsing members
368 Manipulators, vibrators, robots, separators
369 Other

37 Controls
370 General
371 Push-pull
372 Transducers (to mechanical)
373 Gyros, gyroscopes
374 Mechanical counters
375 Safety devices, audible warning devices
376
377
378
379 Other

39 Systems
390 General

4—ASSEMBLY COMPONENTS

41 Fasteners
410 General
411 Inserts
412 Nuts, locknuts
413 Pins, dowels, staples
414 Quick operating panel-type, latches
415 Retaining rings, keys, collars, frictional shaft connectors, shaft-hub connectors, tolerance rings
416 Rivets, blind rivets
417 Screws, bolts, studs, shear bolts
418 Washers, grommets, eyelets, spacers, bushings, stand-offs
419 Other: Spring clips, clamps, zippers, wire ties, belt splicing, captive panel hardware, captive fasteners

42 Springs and Isolation Devices
420 General
421 Fluid & air springs
422 Helical wire springs
423 Leaf springs, cantilever
424 Vibration isolators, mounts
425 Hydraulic-damping devices, shock absorbers, snubbers
426 Mechanical damping devices
427 Spring-loaded devices
428
429 Other: Belleville, constant force

43 Miscellaneous
430 General
431 Locks
432 Nameplates, labels, wire markers, signs
433 Dials, knobs, handles, drawer pulls
434 Shims
435 Enclosures, housings, cabinets, cases
436 Wheels, tires, rollers, casters, ball transfers, rings
437 Slides, ways
438 Hinges, brackets
439 Other: Razor blades, brushes, bells, knives, buzzers, chimes, bases, boots, bellows, way protectors

44 Mechanical Measurement Equipment
440 General
441 Inspection tools and fixtures
442 Gage blocks, micrometer heads
443 Meters, gages

5—MATERIALS

51 Ferrous Metals
510 General
511 Cast iron, malleable iron, cast carbon, alloy steels
512 Wrought carbon, alloy steels
513 Free-machining steels
514 Stainless steels, high alloys, high temperature steels
515 Specialty steels (tool, die, electrical)
516
517 High-strength low-alloys
518 Magnetic alloys
519 Other

52 Nonferrous Metals
520 General
521 Aluminum
522 Copper, brass, bronze, beryllium copper
523 Magnesium
524 Nickel
525 Titanium
526 Zinc
527 Refractory metals: Tungsten, tantalum, molybdenum, columbium
528 Precious metals
529 Other: Tin, lead, chromium, vanadium

53 Plastics
530 General
531 Thermoplastic plastics (nylon, Teflon)
532 Thermosetting plastics (epoxy, phenolic, filled silicones, rigid urethanes)
533 Laminated plastics, vulcanized fiber
534 Reinforced, filled plastics
535 Porous plastics
536 Colors for plastics
537 Plastic trims
538
539 Other: Degradable

54 Rubber and Elastomer
540 General
541 Natural rubber
542 Synthetic rubber
543 Elastomeric plastics: Flexible silicones and urethanes
544 Hard rubber
545
546
547
548
549 Other

55 Joining Materials
550 General
551 Adhesives, sealants, encapsulants, caulking, grout
552 Welding rods
553 Brazing, soldering alloys
554
555
556
557
558
559 Other

56 Other Nonmetals
560 General
561 Carbon, graphite, diamonds
562 Glass, ceramics, quartz
563 Refractory materials, mica
564 Carbides, cermets
565 Mineral and synthetic fibers, felt, fabrics
566 Insulating materials (thermal, sound)
567 Wood, cork, composition board, paper
568 Chemicals, phosphors, inks
569 Other: Abrasives, friction materials, synthetic crystals, heat-sensitive liquid crystals

57 Finishes, Coatings & Lubricants
570 General
571 Metallic coatings
572 Chemical coatings, electrochemical coatings, photosensitive
573 Organic finishes: Lacquers, synthetic enamels, paints, varnishes
574 Porcelain enamels, vitreous coatings
575 Plastic coatings, plastic powders
576 Lubricating materials (see 214)
577 Cleaners, solvents (see 213)
578 Mechanical surface finishes
579 Other: Corrosion inhibitors

58 Prefabricated Forms
580 General
581 Film, tape, sheet, foil, plate
582 Wire, wire cloth, knitted wire mesh, wire rope, cable
583 Patterned, perforated, expanded metals, textured, prefinished
584 Laminates
585 Composite materials
586 Structures: Honeycomb, foam, sandwich, isogrids, geodesic
587 Structural shapes: Tubing, channels
588 Balls, beads
589 Other

7—DESIGN THEORY & TECHNIQUES

71 Mechanics
710 General
711 Statics (at rest)
712 Dynamics (force to create motion)
713 Kinematics (motion in abstract)
714 Vibration, natural frequency
715 Shock
716 Noise, sound, music
717 Viscosity
718 Strain and stress
719 Other

72 Strength of Material
720 General
721 Elastic theory
722 Plastic theory
723 Fatigue, endurance
724 Creep
725 Impact stress
726 Thermal stress
727 Friction, wear
728 Fracture
729 Other: Hardness

73 Strength of Parts
730 General
731 Tension, compression
732 Bending
733 Shear, torsion
734 Surface contact stress
735 Plates
736 Cylinders, columns
737 Rotating discs, rotors
738 Critical speed, critical flow
739 Other

74 Human-Factors Engineering
740 General
741 Styling
742 Color
743 Safety, comfort, protective clothing
744 Illumination
745 Human limitations
746 Spare/replacement parts
747
748
749 Other: Tactile graphics

75 Design Analysis & Synthesis
750 General
751 Mathematical methods, statistics
752 Graphical techniques
753 Analogs, models, simulators
754 Computer techniques
755 Reliability, quality control
756 Dimensioning, tolerances
757 Maintenance
758 Value analysis
759 Other

76 Basic Sciences & Fields
760 General
761 Physics
762 Chemistry
763 Thermal, thermodynamics, cryogenics, heat transfer, combustion
764 Radiation
765 Biosciences
766 Optics, photography, holography, photoelasticity
767 Ultrasonics
768 Aerodynamics
769 Other: Economics, metrology

77 Experimental Design
770 General
771 Prototypes, breadboards
772 Testing, stress analysis
773
774
775
776
777
778
779 Other

78 Environmental Design
780 General
781 Corrosion, rust
782 Mold, fungus
783 Outer space
784 Under sea
785 Pollution
786 Waste treatment, reclamation, salvage, restoration, conservation, recycling
787
788 High temperature, low temperature
789 Other

6—MANUFACTURING PROCESSES

61 Metal Casting
610 General
611 Sand
612 Shell mold
613 Permanent mold, gravity, low-pressure
614 Centrifugal
615 Investment
616 Die
617 Plaster mold
618 Continuous
619 Other

62 Metal Shaping
620 General
621 Forging, cold forging
622 Extrusion, impact extrusion
623 Heading, upsetting, cold forming
624 Thread, form rolling
625 Powder metallurgy, porous metals, fiber metals
626
627
628 Hot isostatic pressing
629 Other

63 Metal Forming
630 General
631 Sheet forming, plate forming
632 Stamping, drawing, blanking, embossing, coining
633 High-velocity forming, explosive forming
634 Spinning
635 Roll forming
636 Tube forming
637 Wire forming
638 Stretch and compression forming
639 Other: Magnetic forming

64 Metal Joining
640 General
641 Arc welding
642 Gas welding
643 Resistance welding
644 High-energy welding: Plasma, electron beam, explosive bonding, ultrasonic, magnetic, solid state
645 Flame cutting
646 Brazing
647 Soldering, desoldering
648 Adhesive joining, bonding
649 Other: Interlocking, keylock, dove-tail, sewing, bolted joints, riveting

65 Metal Removal
650 General
651 Planing, broaching
652 Lathe turning, screw machining
653 Milling, hobbing, gear shaping, sawing
654 Drilling, boring, tapping
655 Grinding, abrasive machining
656 Honing, lapping, polishing, burnishing
657 High-energy machining: Spark, laser, water jet
658
659 Other

66 Metal Treating
660 General
661 Heat treating
662 Surface treating: Carburizing, nitriding
663 Shot peening, surface working
664 Chemical milling, etching, photochemical machining
665
666
667
668
669 Other

67 Finishing
670 General
671 Chemical, solvent cleaning
672 Mechanical finishing, tumbling
673 Conversion coating, anodizing, electropolishing
674 Electroplating, vacuum metallizing
675 Metal spraying, flame spraying, hard facing, plasma spray, plasma arc, electrostatic
676 Painting
677 Hot stamping: Branding
678
679 Other

68 Plastics & Rubber Processes
680 General
681 Molding, injection molding, forging, rotational molding
682 Extrusion, pultrusion
683 Sheet forming
684 Laminating
685 Casting
686 Stamping, machining, fabricating, forming, forging
687 Calendering, coating, plating
688 Encapsulating
689 Other: Filament winding, welding

69 Miscellaneous
690 General
691 Assembly, automatic assembly, micro-assembly
692 Packaging, storage, shipping
693 Balancing rotating machines

8—ENGINEERING MANAGEMENT & OPERATION

81 Engineering Department Operations
810 General
811 Structure, organization
812 Costs, budgets
813 Programming, planning
814 Personnel policies
815 Recruiting, evaluation, training
816 Managerial talent
817 Compensation, pensions
818 Communication
819 Other

82 New Product Development
820 General

83 Drafting & Reproduction
830 General
831 Management, control systems
832 Drafting practices, techniques
833 Technical illustration
834 Drafting equipment
835 Reproduction equipment, systems
836 Furniture, drawing files
837
838
839 Other

84 Laboratory & Testing
840 General
841 Nondestructive testing
842 Dynamic analysis

85 Technical Information
850 General
851 Engineering libraries, files, books, museums
852 Information classification, retrieval
853 Specifications, standards, metrication
854 Report writing, articles, papers, oral
855 Part numbering, part names (nomenclature)
856 Engineering records
857
858 Security, protection
859 Other

86 Patents & Patent Law
860 General

87 Personal & Professional
870 General
871 Creativity, inventiveness
872 Meetings, shows
873 Contests, awards
874 Societies
875 Professional licensing, certification
876 Unions
877 Education, curriculums, seminars, career planning
878 Product litigation, expert witness
879 Other: Women

88 Outside Services
880 General
881 Engineering design services
882 Industrial design services
883 Consulting to government
884
885
886
887
888
889 Other

9—MISCELLANEOUS

91 Complete Machines
910 General
911 Ordnance: Tanks, missiles, rockets, ammunition (SIC 19)
912 Machinery: Agricultural, construction, machine tools, office machines, materials handling (SIC 35)
913 Electrical machinery: Communication, radio, radar, TV, appliances, X-ray (SIC 36)
914 Transportation: Automotive, aircraft, ships, railroad, spacecraft, undersea craft (SIC 37)
915 Instruments: Medical, dental, photographic, watches (SIC 38)
916 Fabricated metal products: Hand tools (SIC 34)
917 Toys, playground equipment, sports equipment, recreational equipment
918
919 Other

99 Unclassified
990 General